

# Livestock Production Competitive, But Exports Remain Small

Francis Tuan, Qingbo Cao, and Tingjun Peng

**Highlights:** China's livestock production has developed rapidly since it began using more manufactured feed in the 1980s. Meat output grew significantly over the past two decades, as did rural and urban per capita meat consumption. The decline in livestock prices that began in 1996 was halted in 2000. Some prices have rebounded. Although production of China's livestock products is quite competitive, exports of livestock products remain low because of disease and quality issues.

---

China's livestock sector has changed significantly since the mid-1980s due to market liberalization as well as modernization and commercialization of livestock production. Increases in income and population in China have boosted demand for livestock products. The livestock sector's share of agricultural output nearly doubled, from 15 percent at the beginning of rural reforms in the 1970s to 29 percent in 1999. While indicators of the economic cost of livestock production suggest that China's livestock industry is quite competitive, large exports have yet to materialize.

## *Greater Use of Feed Grains*

Despite a long history of livestock-raising activities, China's livestock industry did not begin to develop rapidly until the mid-1980s. Even today, most meat is still produced with traditional "backyard" methods—that is, rural households raise animals on a small scale to supplement their farm income. However, households specializing in livestock-production activities as their principal occupation now account for an increasing share of production. These "specialized households" rely far less on homegrown grain and farm by-products and are more responsive to grain prices than traditional backyard operations.

As recently as the early 1980s, most of China's domestic animals, including hogs, cattle, goats, sheep, and chickens, were fed in the backyards of farm households. Hogs ran free or were kept in small,

partially roofed pigsties. Cattle, goats, and sheep were either fed in small pens or herded along the sides of roads and edges of fields, where they could eat weeds. Before the 1980s, cattle were raised primarily for plowing, and because manufactured fertilizer was scarce, manure was a valuable by-product of animal husbandry.

Depending on the type of animal, feed ingredients generally included low-quality grains, tubers, grain by-products, table scraps, brewery residues, green silage, melons, water plants, and other vegetation. Oilseed meals were not used extensively; rather, they served mainly as a fertilizer for crops. Large amounts of feed grains, together with soybean meal or rapeseed meal, were used as animal feed only later, and then introduced only gradually, beginning around the mid-1980s.

Pork production is the core of China's livestock industry. In 1999, pork contributed about 84 percent of China's red meat production and 67 percent of total meat output (see table H-2). At present, about 80 percent of China's pork output comes from backyard operations, 15 percent comes from specialized households (that are principally employed in hog raising), and 5 percent comes from large-scale commercial operations. In the mid-1980s, about 95 percent of hogs were raised by backyard enterprises. This structural change in hog production improved feed efficiency and increased output significantly (Fang et al.).

Improved feeding efficiency helped reduce seasonal variations in pork supplies, largely eliminating dependence on frozen meat during seasons when production was traditionally low. Improved feeding efficiency in livestock production over the past 10-15 years significantly shortened China's livestock production cycles. For example, hogs raised in southern China now require only 4 months to reach marketable weight (about 100 kg), compared with 7 months needed in the 1980s. Hogs raised in northern China now need about 6 months to reach slaughter weight, compared with 10 months needed in the 1980s. Today, meat quality and feed efficiency are increasingly important goals. These goals will become even more critical as China prepares to join the WTO.

### Changing Production Structure

In the early 1980s, pork contributed over 90 percent of China's total meat output. Pork's share fell to around 80 percent in 1990 and only 67 percent in 1999 (fig. H-1). Other meats, including poultry, have grown significantly as a share of China's total meat output in the same period. Poultry production, with its high feed-conversion ratio, has made more efficient use of China's feed supply. Poultry's share of China's total meat production grew from 11 percent in 1990 to nearly 19 percent in 1999.

During the 1990s, livestock production became more geographically concentrated in major corn-producing

provinces of northeastern China (Jilin, Liaoning, and Heilongjiang) and the north China plain (Hebei, Henan, Shandong, and Shanxi). Many provinces in this region doubled or even tripled meat output. The share of meat produced in northeastern China and the north China plain rose about 10 percentage points during the 1990s, reaching 36.2 percent in 1999.

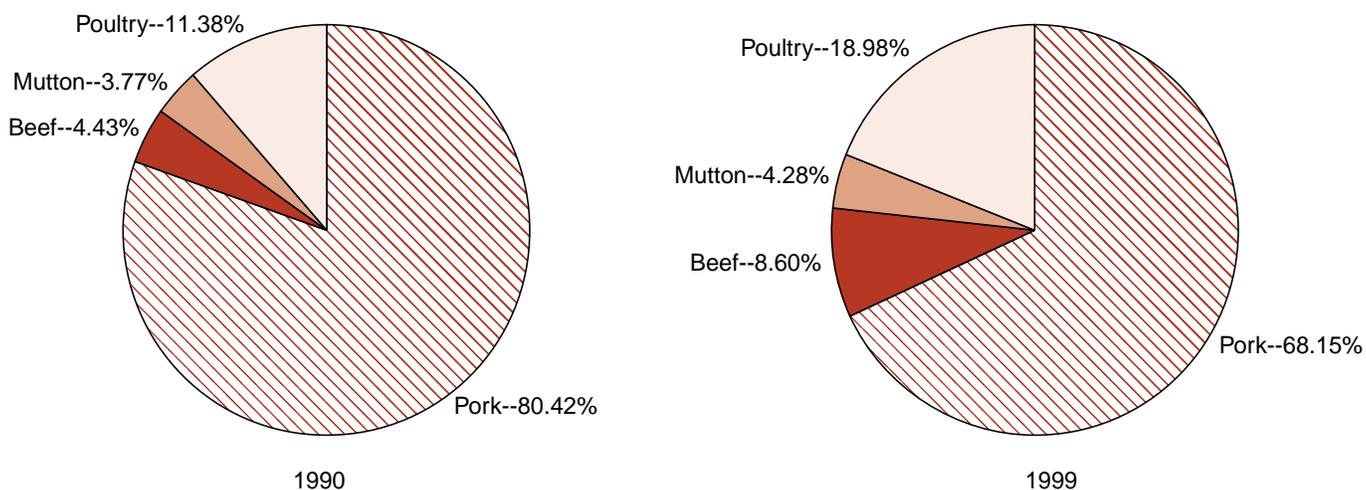
### Meat Consumption Rising, But Prices Weak

Apart from pork consumption, China's per capita consumption of livestock products is still low, compared with Japan, Hong Kong, Taiwan, and Korea (Crock). Meat consumption, however, is growing steadily. Over the past two decades, both rural and urban per capita meat consumption has increased. Rural households (nearly 70 percent of China's consumers) raised their per capita consumption of meat and fish from 12.4 kg in 1983 to 20 kg in 1999, an increase of over 60 percent (table H-1). Urban households consumed more than twice as much meat and fish per capita as did rural households in 1983 (30.6 kg). Urban households also increased consumption, but the increase from 1983 to 1997 was only 15 percent.

The rate of increase in consumption appears to have lagged behind growth in production. Meat production statistics show an increase of over 300 percent from 1983 to 1999, a rate that far exceeds the rate of growth in per capita consumption and population growth. The volume of exports has also been modest. A major reason

Figure H-1

Changes in shares of China's total meat output, 1990-99



Source: China's Ministry of Agriculture.

**Table H-1—Per capita consumption of food grain, livestock products, and fishery products for rural and urban residents, 1983-99**

Year	Food grain		Red meat		Poultry meat		Fishery products	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
<i>Kilograms</i>								
1983	260.0	144.5	10.0	19.9	0.8	2.6	1.6	8.1
1984	267.0	142.5	10.6	19.1	0.9	2.9	1.7	7.8
1985	257.0	134.8	11.0	18.8	1.0	3.2	1.6	7.1
1986	259.0	137.9	11.8	21.7	1.1	3.7	1.9	8.2
1987	259.0	133.9	11.7	21.1	1.2	3.4	2.0	7.9
1988	260.0	137.2	10.7	19.9	1.3	4.0	1.9	7.1
1989	262.0	133.9	11.0	20.4	1.3	3.7	2.1	7.6
1990	262.0	130.7	11.3	21.8	1.3	3.4	2.1	7.7
1991	256.0	127.9	12.2	22.3	1.3	4.4	2.2	8.0
1992	251.0	111.5	11.8	21.5	1.5	5.1	2.3	8.2
1993	266.0	97.8	11.7	20.9	1.6	3.7	2.5	8.0
1994	257.0	102.0	11.0	20.3	1.6	4.1	3.0	8.5
1995	258.9	97.0	11.3	19.8	1.8	4.0	3.4	9.2
1996	256.2	94.7	11.9	20.5	1.9	5.4	3.7	9.3
1997	250.7	88.6	12.7	19.1	2.4	6.5	3.4	9.3
1998	249.3	86.7	13.2	19.3	2.2	6.3	3.6	9.8
1999	247.5	84.9	13.7	20.0	2.5	4.9	3.8	10.3

Note: Consumption statistics for urban residents are actual quantities purchased.

Source: *China's Statistical Yearbook*, various issues.

for the discrepancies between output and the consumption of meat is the exclusion of away-from-home consumption of meat in the consumption statistics. The statistics likely understate meat consumption because eating away from home has grown markedly over the past 10 years, especially among urban residents.

The discrepancy between consumption and production could also be due to statistical over-reporting of meat output. Since 1997, however, a reduction of hog inventory estimates based on the results of China's first agricultural census has reduced this discrepancy (Colby et al.). China's meat output estimates were adjusted downward by about 20 percent for 1997-99 (table H-2). Still, even after making the adjustment, a pattern of rapid growth in meat output is observed (fig. H-2).

The oversupply of animal products suggested by the statistics should have depressed prices throughout the last 20 years. However, the prices of livestock products grew at a steady pace until 1996. Livestock product prices, like the prices of most grain products, plunged in 1996 and stayed at depressed levels until 2000.

As incomes in China grow, meat demand can be expected to grow further. A U.S. Department of Agriculture Economic Research Service analysis based on China's price and income statistics since the early 1980s found that poultry demand was more sensitive to income growth than pork demand and that rural meat demand responded more to income growth than urban demand (Cao and Huang). Based on these estimates and 1999 consumption levels, a 10-percent increase in income would lead to a 0.17-kg increase in urban per capita pork consumption and a 0.73-kg increase in rural consumption (table H-3). These estimates reflect the much faster growth in rural pork consumption over the past two decades and suggest that much of the potential growth is in rural households. However, rural income growth has been weaker than urban income growth in recent years. Also, per capita pork consumption levels are still significantly higher in urban areas, so the increase in urban population may also play an important role in raising pork consumption.

Poultry consumption per capita would grow by similar amounts in rural and urban households following a 10-percent growth in household income—0.37 kg in urban households and 0.41 kg in rural households.

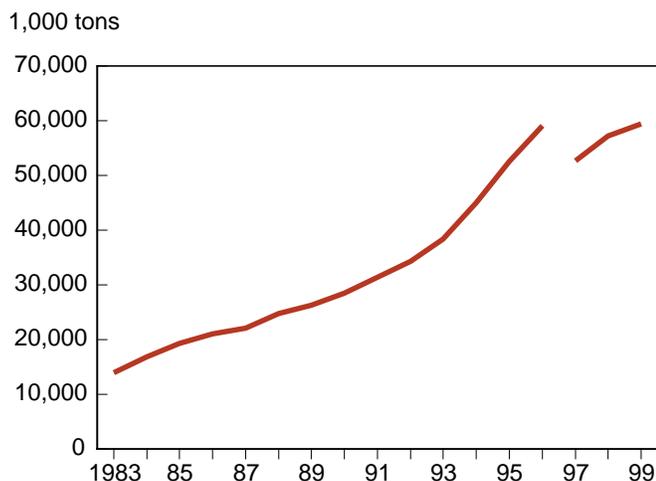
**Table H-2—China's major livestock outputs, 1983-99**

Year	Total meat output	Red meat	Pork	Beef	Mutton	Poultry meat	Eggs	Cow milk
1,000 tons								
1983	14,030	14,030	13,160	321	550	na	3,320	1,845
1984	16,900	15,410	14,450	371	590	1,490	4,320	2,186
1985	19,270	17,610	16,550	471	590	1,600	5,350	2,499
1986	21,120	19,170	17,960	591	620	1,880	5,550	2,899
1987	22,160	19,860	18,350	791	720	2,190	5,900	3,301
1988	24,800	21,940	20,180	961	800	2,740	6,960	3,660
1989	26,290	23,260	21,230	1,071	960	2,820	7,200	3,813
1990	28,570	25,140	22,810	1,261	1,070	3,230	7,950	4,157
1991	31,440	27,240	24,520	1,541	1,080	3,950	9,220	4,644
1992	34,310	29,400	26,350	1,801	1,250	4,540	10,200	5,031
1993	38,420	32,250	28,540	2,341	1,370	2,740	11,800	4,986
1994	44,990	36,930	32,050	3,271	1,010	7,550	14,790	5,288
1995	52,600	42,650	36,480	4,151	2,020	9,350	16,770	5,764
1996	59,150	47,730	40,380	4,951	2,400	10,750	18,540	6,294
1997	52,690	42,500	35,960	4,411	2,130	9,790	18,950	6,011
1998	57,240	45,990	38,840	4,801	2,350	10,560	20,190	6,629
1999	59,490	47,620	40,060	5,051	2,510	11,160	21,350	7,176

Note: na = not applicable.

Source: *China's Statistical Yearbook*, various issues. All statistics after 1996 have been corrected by the National Bureau of Statistics according to China's Agricultural Census results.

Figure H-2

**China meat production, 1983-99**

Source: *China's Statistical Yearbook*, various issues. All statistics after 1996 have been corrected by the National Bureau of Statistics according to China's Agricultural Census results.

Although the increases are similar, the proportionate increase is larger in rural households since that segment begins from a lower base level of consumption. The estimates suggest that poultry will continue to increase its share of both rural and urban consumption relative to pork as incomes rise. Although rural households increase their consumption of pork by almost 2 kg for every 1 kg increase in poultry, this ratio is much lower than the ratio of 5 kg of pork for every 1 kg of poultry consumed in 1999.

Again, official consumption statistics probably understate growth in meat consumption because the statistics exclude food consumed away from home. The actual growth in meat consumption is likely to be much greater when meat consumed in restaurants, food stalls, and institutions, such as schools and research institutes, is taken into account.

In 1999 and 2000, growth in consumption of livestock products in both urban and rural areas slowed due to

**Table H-3—Increased rural and urban pork and poultry consumption from a 10-percent increase in income**

Item	Pork		Poultry	
	Urban	Rural	Urban	Rural
Per capita consumption, 1999 (kg)	16.9	12.9	4.9	2.5
Estimated income elasticity	0.10	0.57	0.76	1.65
Increase in consumption due to 10-percent increase in income (kg) <sup>1</sup>	0.17	0.73	0.37	0.41

Note: Estimates for beef and mutton price elasticities were also made but are not shown in the table.

<sup>1</sup>Increase in consumption calculated using income elasticity and 1999 per capita consumption, assuming prices and other factors held constant.

Sources: *China Statistical Yearbook and China Rural Household Survey Yearbook*, 2000; Cao and Huang.

increased unemployment, downsizing of state-owned enterprises in urban cities, and falling incomes in rural areas (fig. H-3). Government reforms in housing, health, and prescription drug policies also affected disposable income, reducing purchases of nonstaple food, particularly meat.

Prices of major livestock products tended to decline in recent years, with weakening demand and strong production growth. In 2000, pork, beef, and mutton prices were stable, but poultry and egg prices fell and rose slightly during the second half of the year (fig. H-4). Falling poultry prices during the first half of 2000, due to rapidly increasing poultry production (particularly near large cities), may have contributed to the increase in poultry consumption. Cao and Huang estimated that a 10-percent decrease in poultry prices leads to a 5.3-percent increase in urban per capita poultry consumption and a 2.8-percent increase in rural poultry consumption.

For 2001, China's Ministry of Agriculture projects that changes in pork prices will become seasonal as output continues to increase. China's consumers have preferred to eat more beef and mutton in recent years due to rising incomes. Beef and mutton prices are expected to stay stable, similar to prices in 2000. In contrast, poultry meat and eggs have been over supplied in recent years and their prices in 2001 will likely remain low and unstable, similar to prices in 2000.

### ***Livestock Share of Trade Is Small***

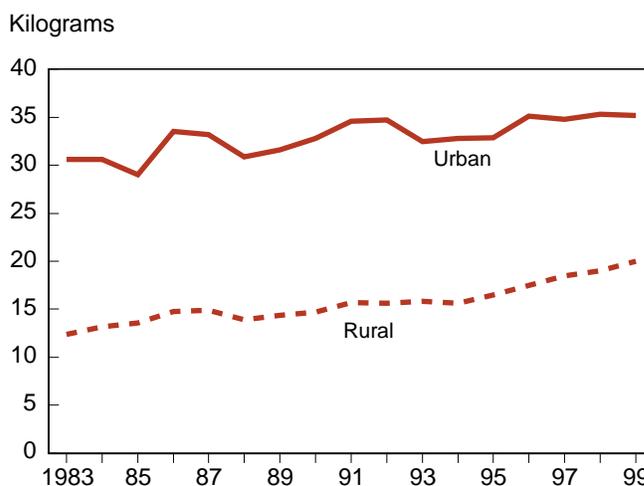
China's imports and exports of livestock products, in terms of both volume and value, are small shares of total agricultural trade. Until 1970, the animal products' (mostly pork and live hogs) share of total value of agricultural exports was about 10 percent. Since the early 1980s, the quantities of exported meat and live

animals, in general, have been stable. Livestock products' share of total agricultural exports has decreased as agricultural trade expanded due to foreign trade liberalization and government promotion of other agricultural exports, such as grain, horticultural products, and processed food.

Over the past four decades, China predominantly shipped live animals, pork, beef, and poultry to a small group of countries (see table H-4 for 1992-99 trade). Hong Kong and Macau were the major export destinations for China's live animal exports. Poultry meat was mainly shipped to Japan. Pork and beef were exported to Russia, with a small portion also going to Hong Kong and the Middle East. China also imports specific poultry cuts, mainly feet and wings, from Hong Kong.

Figure H-3

### **Per capita consumption of meat and fish, rural and urban residents, 1983-99**



Note: Consumption statistics for urban residents are actual quantities purchased. Food consumed away from home is not included.

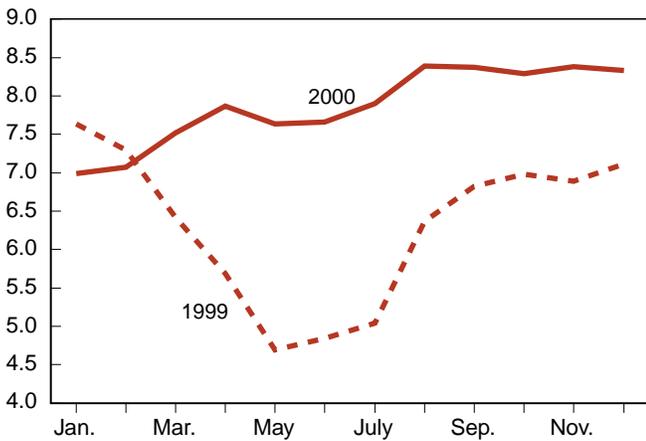
Source: *China's Statistical Yearbook*, various issues.

Figure H-4

**Changes in rural market prices of hogs, beef, mutton, chicken, and eggs, 1999-2000**

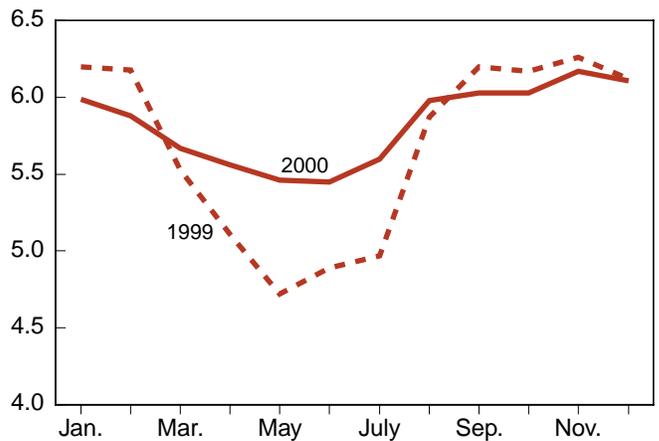
**Feeder pigs**

Yuan per kilogram



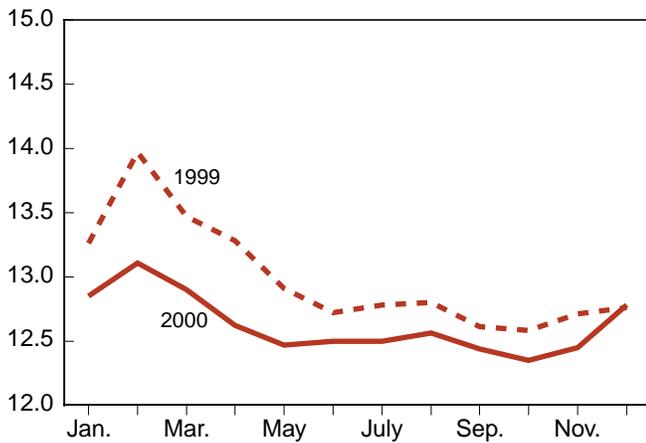
**Live hogs**

Yuan per kilogram



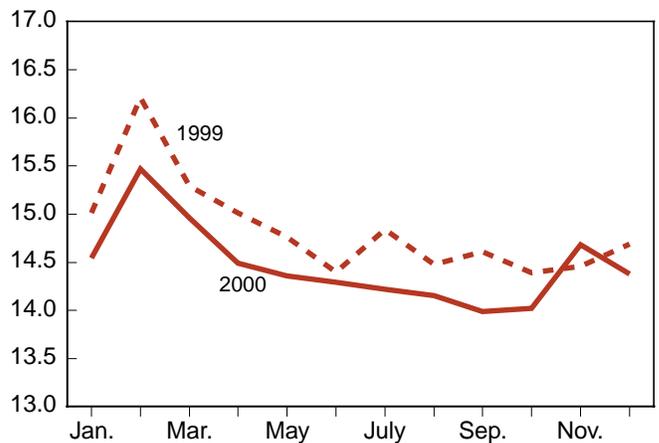
**Boneless beef**

Yuan per kilogram



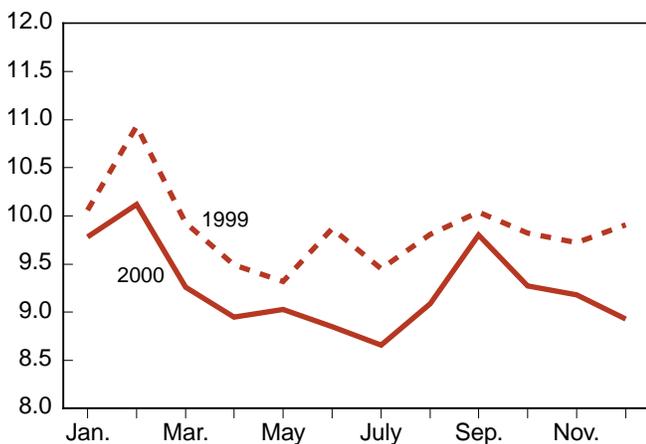
**Mutton, bone-in**

Yuan per kilogram



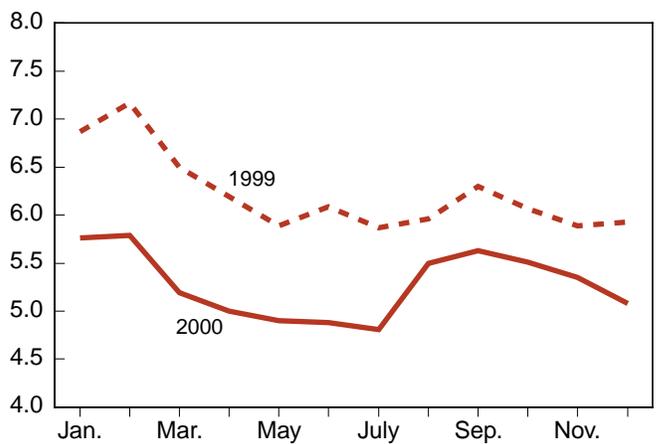
**Live chickens**

Yuan per kilogram



**Eggs**

Yuan per kilogram



Source: China's Ministry of Agriculture.

**Table H-4—Volume and value of China's trade of major livestock products, 1992-99**

Year	Frozen, fresh		Frozen, fresh		Chicken	Eggs
	Live hogs	Live poultry	beef	pork	meat	
	-----1,000 head-----		-----1,000 tons-----			Million pieces
<b>Exports:</b>						
1992	2,900	49,557	24	50	93	--
1993	2,720	51,150	22	60	107	611
1994	2,700	52,300	20	100	164	486
1995	2,533	52,630	20	154	249	358
1996	2,402	53,773	29	129	304	520
1997	2,270	52,675	31	103	303	733
1998	2,195	42,616	43	105	286	577
1999	1,958	45,000	19	54	315	466
<b>Imports:</b>						
1992	--	2,684	1	--	78	--
1993	--	1,710	2	--	99	4
1994	1	1,849	3	--	136	6
1995	97	1,788	3	3	261	2
1996	1	1,362	3	2	308	3
1997	11	1,077	3	3	205	2
1998	2	715	4	16	192	2
1999	na	na	5	58	760	na
<i>Million dollars</i>						
<b>Exports:</b>						
1992	290	94	39	76	166	--
1993	272	90	28	63	185	28
1994	269	105	31	128	380	18
1995	278	125	34	245	621	17
1996	291	121	51	215	643	25
1997	299	114	54	195	568	25
1998	289	96	73	181	483	19
1999	236	99	26	67	500	12
<b>Imports:</b>						
1992	--	26	4	0	50	--
1993	--	11	5	0	58	1
1994	1	10	5	0	72	1
1995	2	15	4	1	80	2
1996	2	15	4	1	138	1
1997	2	14	3	2	127	1
1998	3	10	5	7	106	1
1999	4	11	6	24	392	1

Note: -- = negligible amount. na = not applicable.

Sources: China's Customs statistics and *China Monthly Exports and Imports*, December, various years.

In general, China has been a net exporter of livestock products. However, with the exception of poultry and meat, annual trade values of China's livestock products have generally been small. Poultry exports have grown rapidly, but the quantity is still quite low. Neither the structural change in China's livestock production nor the growing discrepancy between China's livestock production and consumption levels has resulted in an increase in livestock product trade.

Several factors account for China's low trade in livestock products. First, the government uses high tariffs and quotas to limit imports of meat products to insulate the domestic industry from foreign competition. Throughout the 1980s (and even, to a limited extent, in the 1990s) the government managed trade of livestock products, particularly imports, relatively closely. Second, China faces a number of disease-control issues (e.g., foot-and-mouth disease) that limit its ability to export. Finally, China's poor infrastructure and transportation system make it difficult to transport and store commodities. In particular, the lack of sufficient refrigeration facilities, both in terms of fixed storage and rail or truck, limits the trade in fresh or frozen meat products.

### ***China's Livestock Products Internationally Competitive***

As China nears accession to the World Trade Organization (WTO), there is growing interest in evaluating the country's potential for increasing exports of livestock products. This potential, in part, depends on production costs, domestic and international market prices, exchange rates, transportation costs, disease control, and other factors.

Does China have a comparative advantage in livestock production compared with other major countries? ERS measured several indicators developed by Pearson in 1976—domestic resource cost coefficients (DRCC), net social profitability (NSP), and effective rate of protection (ERP)—to evaluate the comparative advantage of livestock production in China for the period 1990-98 (see box). Indicators were measured for three animal products—hogs, cattle, and broilers—and three grains—wheat, rice, and corn.

Major findings from the estimated results can be briefly summarized as follows (table H-5):

1. Production of hogs (backyard production activities), beef cattle (rural household production), and broil-

## **Indicators of Comparative Advantage**

***Domestic Resource Cost Coefficient (DRCC)***—Assuming free trade, DRCC of an agricultural commodity can be estimated by dividing its domestic resource costs (DRC) with shadow exchange rates, where DRC is the sum of opportunity costs of all domestic resources needed to produce (or to save) an additional unit of shadow income (or foreign exchange). If  $DRCC < 1$ , it indicates that the product generates an income higher than input costs used, and therefore the country has some comparative advantage in producing the commodity. On the contrary,  $DRCC > 1$  indicates a disadvantage in producing the product because the additional unit of output is worth less than the total costs needed for producing such an output.

***Net Social Profitability (NSP)***—Net social profitability can be estimated by subtracting all input costs from the sum of their opportunity costs plus any externalities. NSP indicates the profit of producing a commodity by efficiently utilizing all foreign and domestic resources. Therefore,  $NSP > 0$  indicates positive profitability of growing or raising a product. If  $NSP < 0$ , the product is not profitable, indicating an inefficient allocation of resources in production of the output.

***Effective Rate of Protection (ERP)***—ERP reflects the increased percentage of added value of one commodity due to protection policies relative to what would occur under free trade conditions.  $ERP > 0$  reflects positive protection, meaning that current comparative advantage would be reduced if protection policies are removed, hence decreasing the trade competitiveness of the product in the international market.  $ERP < 0$  indicates that the product receives negative protection. Removing negative support of a product would increase its trade competitiveness in the international market.

ers (specialized household production) was fairly competitive. Estimates of degrees of comparative advantage (DCA) for hogs ranged between 0.37 and 0.61, beef cattle estimates ranged between 0.48 and 0.79, and broilers estimates ranged between 0.24 and 0.60. For example, in 1990, DCA estimates were 0.45 (hogs), 0.63 (beef cattle), and 0.43 (broilers), implying production of 1 unit of shadow income for the respective animals required units of

input of 0.55 (hogs), 0.37 (beef cattle), and 0.57 (broilers). Similarly, in 1998, producing a unit of shadow income from hogs, beef cattle, and broilers required units of input of 0.45 (hogs), 0.39 (beef cattle), and 0.40 (broilers). The estimates indicate that China's comparative advantage in producing the three livestock animals remained strong.

Unlike for livestock products, China's comparative advantage in grain production has gradually fallen.

For example, in 1990, the DCA estimate for wheat production was 0.31, implying wheat growing was competitive and efficient. However, the same estimate fell to negative 0.20 in 1993, indicating that producing 1 unit of shadow income required 1.20 units of inputs. Since 1993, estimated DCAs for wheat have remained negative, explaining why Chinese researchers and government officials frequently indicate that China would likely import wheat in the future.

**Table H-5—The degree of comparative advantage, net social profitability, and effective rate of protection of China's major grain and animal products, 1990-98**

Commodity	1990	1991	1992	1993	1994	1995	1996	1997	1998
<b>DCA:</b>									
Hogs	0.45	0.59	0.55	0.61	0.58	0.47	0.39	0.37	0.55
Cattle	0.63	0.48	0.68	0.70	0.61	0.76	0.79	0.76	0.61
Broilers	0.43	0.41	0.24	0.49	0.47	0.51	0.45	0.39	0.60
Wheat	0.31	0.25	0.24	-0.20	-0.27	-0.28	-0.10	-0.18	-0.07
Rice	0.69	0.69	0.78	0.72	0.58	0.53	0.30	0.12	0.16
Corn	0.54	0.64	0.49	0.51	0.38	0.02	-0.09	-0.17	-0.20
<i>Yuan per kilogram</i>									
<b>NSP:</b>									
Hogs	0.79	1.57	1.27	1.71	2.44	1.83	1.39	1.32	0.91
Cattle	3.39	2.66	3.71	3.22	3.13	3.28	4.12	3.55	1.18
Broilers	1.58	1.41	0.54	2.16	2.43	2.84	1.99	1.79	0.64
Wheat	0.16	0.13	0.13	-0.09	-0.12	-0.16	-0.09	-0.15	-0.06
Rice	0.65	0.62	1.19	0.86	1.01	0.86	0.38	0.13	0.14
Corn	0.28	0.41	0.26	0.21	0.24	0.01	-0.06	-0.11	-0.11
<b>ERP:</b>									
Hogs	0.57	0.06	0.30	0.15	0.47	0.42	0.73	0.65	0.68
Cattle	-0.57	-0.53	-0.65	-0.58	-0.45	-0.36	-0.41	-0.37	-0.53
Broilers	-0.27	-0.34	-0.10	-0.43	-0.36	-0.49	-0.32	-0.43	-0.55
Wheat	0.49	0.25	0.21	0.36	1.67	1.58	0.55	0.34	0.23
Rice	-0.32	-0.47	-0.59	-0.46	0.02	0.17	0.08	0.09	0.48
Corn	-0.31	-0.46	-0.23	0.24	0.35	0.81	0.52	0.40	0.71

Note: For straightforward interpretation of the results, the  $DCA=1-DRCC$  is calculated and listed in this table.  $DRCC=DRC/(NV*EX)$ , where DRC denotes domestic resource costs, NV denotes the added value based on border prices, and EX denotes the opportunity cost of the foreign exchange, or shadow exchange rate.  $NSP=(U-M-R)*V-\sum FV+E$ , where U denotes output value based on border prices, M denotes value of all importable intermediate input in c.i.f., R denotes the opportunity cost of all foreign used or produced inputs, V denotes shadow exchange rate in terms of domestic currency, FV denotes the opportunity cost of each input needed to produce a product, and E denotes the effect of externality.  $ERP=(t_p-\sum a_i t_i)/(1-\sum a_i)$ , where  $t_p$  denotes the duty rate of output  $p$  and  $t_i$  denotes the duty rates for input  $i$  for producing  $p$ ,  $a_i$  denotes the quantities of importable input  $i$  for producing output  $p$ . DCA and ERP are unitless. Data used for the estimation include production costs from the publication entitled *Compilation of Production Costs of China's Agricultural Commodities*, border prices and volume of imports and exports from the *China Customs Statistics*, commodity prices from the *China Price Yearbooks*, shadow prices from *Economic Evaluation Methods and Parameters on Development Projects*, input quantities and coefficients from the input-output tables published by the National Bureau of Statistics (or SSB), tariff rates from the *China Tax Collections*, and investment and interest payments from the *China Finance Yearbooks*.

Source: Tuan et al., 2001.

2. NSP estimates for hogs, beef cattle, and broilers are all positive and almost all generally greater than 1, although estimated NSP for hogs and broilers declined in the late 1990s. Overall, estimated NSPs appear to indicate that China's production of hogs, beef cattle, and broilers has been efficient, suggesting a reasonable allocation of resources.

On the contrary, NSP estimates indicate that current wheat and corn production in China is not competitive. For 1990, estimated NSPs were 0.16 (rice), 0.65 (wheat), and 0.28 (corn), implying that production of 1 kilogram of rice, wheat, and corn could generate 0.16, 0.65 or 0.28 yuan, respectively, of net profit. In 1998, NSPs for wheat and corn were -0.06 and -0.11, indicating losses of 0.06 yuan (wheat) and 0.11 yuan (corn) for each kilogram produced.

3. Estimated ERPs in table 5 reveal that hog production received positive protection over the entire study period in China, but production of beef cattle and broilers always received negative protection for the same time period. Freer trade, through accession to the WTO or other measures, may reduce the trade competitiveness of China's pork trade in the future. In contrast, reduction or elimination of negative protection of beef cattle and broilers would increase the trade competitiveness of those two products.

As for grains, ERPs for rice and corn became positive, reaching 0.48 and 0.71 in 1998. It implies that rice and corn trade became less competitive in the international market compared with earlier years. If China accedes to the WTO, its trade of these commodities would face great competition if it chooses not to reduce or eliminate its support policy. Wheat, which has a positive ERP throughout the period, would also be affected, although its 1999 ERP is lower than rice and corn.

### ***Summary and Trade Implications***

China's livestock and feed production grew rapidly over the last 20 years. Rapid growth of income due to rural and economic reforms beginning in the late 1970s, together with favorable government policies that facilitated livestock production, steadily increased rural and urban per capita consumption of animal products.

Based on livestock statistics published by the Chinese government, China's per capita availability of livestock products, particularly meat, grew significantly faster than rural and urban per capita consumption. With only small quantities of meat products exported to a few countries, as well as Hong Kong and Macau, parts of China encountered regional surpluses of meat output over the last few years. China's government officials and scholars have begun to explore the possibility of shipping meat to international markets, but large export volumes have yet to materialize.

Indicators incorporating the concepts of domestic resource costs, net social profitability, and effective rate of protection suggest that China's production of hogs, beef cattle, and broilers has been competitive in trade and hence had a comparative advantage in producing those products. This preliminary conclusion is also supported by the estimates of NSP of the three products, because levels of net social profitability in producing the products were positive.

However, the estimated ERP for the three products indicates that hog production has received positive protection. Reduction or elimination of the support would decrease China's comparative advantage in producing hogs and reduce its trade competitiveness. Beef cattle and broilers, in contrast, received negative protection based on ERP estimates. China's government could reduce the negative protection to make the output of beef cattle and broilers more competitive in world markets, particularly as China is expected to join the WTO by early 2002.

It is important to note that world meat and other livestock product trade is also constrained by issues such as sanitary standards. China's hog and chicken exports, for example, are constrained because most countries prohibit the importation of livestock products from disease-endemic nations. This constraint makes China's livestock product trade more difficult than nonanimal product trade. Accession to the WTO will ensure China's access and status on the "international platform" in terms of negotiating conflicts over trading issues with other countries, but sanitary and other livestock trade issues will take a long time to be resolved among all member countries.

## References

- Cao, Qingbo, and Kuo S. Huang. "Urban and Rural Food Demand in China," Unpublished Chinese manuscript, November 2000.
- Cheng, Guoqiang et al. China's Swine Industry Research Team, and U.S. Department of Agriculture (USDA)/Economic Research Service (ERS) China Project Team. *China's Swine Industry Handbook*, Center for International Agricultural Trade, CAAS and ERS, U.S. Department of Agriculture, 1999 (draft in Chinese).
- Colby, Hunter, Funing Zhong, and Mark Giordano. "A Review of China's Meat Production Statistics: New Estimates and Implications for Trade," *Agriculture in China and OECD Countries: Past Policies and Future Challenges*, Center for Co-operation with Non-Members, OECD, Paris, 1999.
- Crook, Frederick W. *The Effects of Government Policies on Animal Protein Production and Consumption*, U.S. Department of Agriculture, Economic Research Service, International Agriculture and Trade Reports: China, WRS-98-3, July 1998.
- Crook, Frederick W., and David J. Harvey. *China's Poultry Economy: Production, Marketing, Foreign Trade and Consumption*, U.S. Department of Agriculture, Economic Research Service, International Agriculture and Trade Reports: China, WRS-98-3, July 1998.
- Fang, Cheng, Frank Fuller, Michael Lopez, and Francis C. Tuan. *Livestock Production Slowly Evolving from Sideline to Principal Occupation*, U.S. Department of Agriculture, Economic Research Service, International Agriculture and Trade Reports: China, WRS-99-4, March 2000.
- Pearson, S.R., N. Akreance, and G. Nelson. *Comparative Advantage in Rice Production: A Methodological Introduction*, FRI Studies, Vol. XV, No. 2, Washington, DC, 1976.
- Peng, Tingjun, and Guoqiang Cheng. "Estimation of Domestic Resource Costs of China's Agricultural Products." *China Rural Observations (Zhongguo Nuncun Guangca)*, Issue 1, 1999 (Chinese language journal).
- Tuan, Francis C. *China's Livestock Sector*, U.S. Department of Agriculture, Economic Research Service, Foreign Agricultural Economic Report No. 226, April 1987.
- Tuan, Francis C., Hunter Colby, and Qingbo Cao. *Demand for Livestock Products Stalls*, U.S. Department of Agriculture, Economic Research Service, International Agriculture and Trade Reports: China, WRS-99-4, March 2000.
- Tuan, Francis C., Guoqiang Cheng, and Tingjun Peng. "Comparative Advantages and Trade Competitiveness of Major Agricultural Products in China," WCC-101 paper, The IMPACT Center, Washington State University, April 2001.
- Tuan, Francis C., Xiaohui Zhang, and Eric Wailes. *China's Pork Economy: Production, Marketing, Foreign Trade and Consumption*, U.S. Department of Agriculture, Economic Research Service, International Agriculture and Trade Reports: China, WRS-98-3, July 1998.